IMPACT ABSORPTION APPARATUS FOR UNMANNED AERIAL VEHICLE

BACKGROUND

[0001] 1. Field

[0002] This disclosure generally relates to the field of aerial vehicles. More particularly, the disclosure relates to safety mechanisms for aerial vehicles.

[0003] 2. General Background

[0004] Unmanned aerial vehicles ("UAVs") such as flying robots, drones, airplanes, helicopters, multicopters, e.g., flying robots that operate in a manner similar to helicopters with multiple propellers, balloons, etc. have become more commonplace in entertainment environments such as theme parks, film sets, sports environments, and news environments. A pilot can wirelessly navigate the UAV from a remote location. Alternatively, the UAV may have an autopilot feature so that it is operated and navigated by a computing device. A human is not present on the UAV during flight of the UAV. UAVs have been used for providing entertainment, aerial cinematography, gathering video, images, and/or audio, etc.

[0005] As UAVs increasingly fly over locations where people are present, safety for those people is an important goal. Equipment malfunction, aerial hazards, and aerial maneuvers are examples of events which may result in a loss of propulsion.

[0006] A previous solution was to attach a parachute to the UAV. The parachute could be ejected via a wireless instruction sent by a pilot or a computing device that operated the UAV or by on-board monitoring systems. A problem with using a parachute is that the parachute can get tangled with propulsion units of the UAV during or after ejection of the parachute. Typical UAVs, e.g. multicopters, are devices that are naturally unstable, hence malfunctions can result in a tumbling vehicle. For example, a multicopter can flip during ejection of the parachute. The parachute could then get entangled with the propulsion units of the multicopter during the flip and not eject properly or not provide much help in decelerating the multicopter if the parachute is ejected. Further, a parachute is often fabricated from a heavy material that significantly slows normal movement. Moreover, a parachute requires a fall distance to deploy and properly decelerate a vehicle. Therefore, a parachute is less effective at low altitude. As a result, a continuing need exists for robust UAV safety systems that do not impede normal operation and that perform well at low altitudes.

[0007] Another solution was the establishment of a geofence. The geofence allows the UAV to fly within a perimeter, e.g., a safe distance away from people or objects. Geofencing restricts the use and benefits of a UAV. Since a geofence is a control system rather than a physical barrier, the UAV can still fly through the geofence as a result of hardware or logic failure.

[0008] There is a continuous need to improve safety performance of UAVs.

SUMMARY

[0009] An unmanned aerial vehicle apparatus comprises a frame and a propulsion mechanism coupled to the frame that propels the frame through the air. A storage device stores one or more airbags and is coupled to the frame. An inflation device coupled to the frame receives an activation signal and in response inflates the one or more airbags prior to an impact of the frame with an object.

[0010] A method comprises propelling an unmanned aerial vehicle through the air. An activation signal is sent to an inflation device that inflates one or more airbags coupled to the aerial vehicle to deploy the one or more airbags from the storage device.

[0011] A system comprises a sensor that determines a condition of a component of an unmanned aerial vehicle. The unmanned aerial vehicle has one or more airbags and an inflation device. Further, the system comprises a processor that receives a signal from the sensor indicative of the condition of the component and sends an activation signal to the inflation device to deploy the one or more airbags from the storage device prior to an impact of the unmanned aerial vehicle with an object.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The above-mentioned features of the present disclosure will become more apparent with reference to the following description taken in conjunction with the accompanying drawings wherein like reference numerals denote like elements and in which:

[0013] FIG. **1** illustrates a UAV system.

[0014] FIGS. **2**A, **2**B, and **2**C illustrate a front view, a side view, and a perspective view of the components of the UAV apparatus illustrated in FIG. **1**.

[0015] FIGS. **3**A and **3**B illustrate an example of the UAV apparatus illustrated in FIGS. **2**A, **2**B, and **2**C partially deploying and fully deploying a first airbag and a second airbag.

[0016] FIG. **4** illustrates the internal electronic components of the electronic control device illustrated in FIGS. **2**A, **2**B, and **2**C.

DETAILED DESCRIPTION

[0017] A UAV comprising an impact absorption device is provided to improve safety in close proximity to a flying UAV. The impact absorption device is inflated by the UAV after detection of a condition that may lead to a ground impact, but prior to that impact. The inflated impact absorption device covers the hard, sharp, and spinning parts of the UAV, e.g., the propellers, the frame, etc. As a result, any impact of the UAV is with an inflated object rather than a hard or spinning UAV component. The impact absorption device is configured to prioritize reducing the effect of impact as opposed to preventing damage to the UAV.

[0018] As an example, the impact absorption device comprises one or more airbags that are each activated by one or more components of the UAV after the UAV detects a condition warranting activation. Such conditions include power failure, motor failure, guidance system failure, unexpected change in control source, navigation failure, air pressure change, change in acceleration or speed, mid-air collision with an obstacle and the like. For instance, a first airbag is positioned above the center of gravity of the UAV whereas a second airbag is positioned below the center of gravity of the UAV. Each airbag has dimensions such that both in total engulf the entire frame structure and propulsion mechanism, e.g., propellers, of the UAV. In contrast with previous approaches, e.g., the parachute configuration, that allowed different components of the UAV to be exposed after the safety mechanism was activated, the UAV uses the